



**U.S. Army Research Institute  
for the Behavioral and Social Sciences**

**Research Report 1710**

# **Report on the Expanded Methodology for Development of Structured Simulation-Based Training Programs**

**Charlotte H. Campbell and Daniel E. Deter**  
Human Resources Research Organization

**Kathleen A. Quinkert**  
U.S. Army Research Institute

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# **U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES**

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Technical review by

Billy L. Burnside  
John R. Hayes

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14. ABSTRACT (Maximum 200 words):  The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and the Force XXI Training Program have sponsored the development of a structured simulation-based training program for selected staffs of conventional mounted brigades. The development effort, entitled the <i>Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation</i> (and known as COBRAS) resulted in construction of training support packages (TSPs) for large-scale exercises and for small-group vignettes. Development of the scenario and all TSP materials followed the guidance found in the <i>Methodology for the Development of Structured Simulation-Based Training</i> , published by ARI in 1995. This report documents an expanded methodology, based on experience in the COBRAS program. The expansion is contained in the <i>Guide for Development of Structured Simulation-Based Training</i> . The Guide contains additional examples and warnings, and more in-depth coverage of TSP construction and formative evaluations. This report discusses the activities in the methodology.					
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**Charlotte H. Campbell and Daniel E. Deter**

Human Resources Research Organization

**Kathleen A. Quinkert**

U.S. Army Research Institute

**Armored Forces Research Unit**

**Barbara A. Black, Chief**

U.S. Army Research Institute for the Behavioral and Social Sciences

5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel

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## FOREWORD

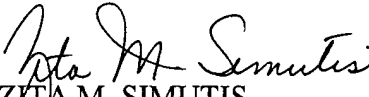
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Within today's Army, two conflicting forces are at work: decreasing resources for training and increasing demands for highly trained and proficient personnel. Force reductions and other cost efficiencies require the Army to reduce its expenditures for high-fidelity institutional and field training. At the same time, introduction of more complex systems and equipment, changes to doctrine and organization, and a changing geopolitical landscape require that training be more committed to quality and efficiency than ever before.

To meet these challenges, Congress provided Fiscal Year 1994 research and development funding for the establishment of the Force XXI Training Program (formerly known as the Virtual Brigade Training Program) at Fort Knox, KY. The intent of this program is to explore and utilize simulation technologies and instructional principles to create structured training programs that fully leverage available resources in providing efficient, effective training to brigade staffs. The focus is on both preparing and equipping the Army of the 21<sup>st</sup> century and ensuring that today's Army is sufficiently ready to provide the foundation for continuing change and modernization.

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), Armored Forces Research Unit (AFRU) at Fort Knox; the Force XXI Training Program; and the U.S. Army Armor Center (USAARMC) joined forces to sponsor training research and development (R&D) for one element of the Congressionally-mandated effort: simulation-based training for the conventional mounted brigade. The R&D work was performed under a project known as the *Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation (COBRAS)*. The project is an element of Research Task 2228 - R03.

This research report describes a methodology for developing structured simulation-based training. It provides the foundation and background for the process presented in the *Guide to Development of Structured Simulation-Based Training* (submitted to ARI for publication). The guide incorporates experience and lessons learned during the COBRAS work, and includes more detailed discussion of training support packages and formative evaluation requirements. This report and the guide itself are designed for use by training designers and developers, as well as by training program reviewers and proponents.

  
ZITA M. SIMUTIS  
Technical Director

  
EDGAR M. JOHNSON  
Director

## ACKNOWLEDGMENTS

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This report summarizes the efforts of a team of military experts, performance analysts, training developers, simulation systems experts, and administrative support personnel. During the course of the 18-month effort to develop the training, some 60 contractor personnel were involved in design, development, implementation, and evaluation. All were staff from four organizations that form the COBRAS Consortium: the Human Resources Research Organization (HumRRO); Hughes Training, Inc.; BDM Federal; and PRC, Inc.

Additionally, we had invaluable support and guidance from a variety of individuals and government organizations, including:

- The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), Armored Forces Research Unit (AFRU)  
Dr. Barbara Black, Chief  
MAJ Richard Campbell, R&D Coordinator
- Force XXI Training Programs  
LTC Bill Martin, Chief  
LTC Toby Martinez, Chief
- TRADOC System Manager for Force XXI  
COL Russ Goehring, TRADOC System Manager
- U.S. Army Armor Center  
MG Larry Jordan, Commander  
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BG Clay Melton, Assistant Commandant  
COL Frederick Treyz, Director, Armor School  
COL Paul Lenz, Chief of Staff of the Armor School  
COL Jerry Veach, Special Assistant to the Commanding General (ARNG)
- Directorate of Training and Doctrine Development  
COL Pat Ritter, Director  
LTC Doug Slater, Chief of Force XXI Training Program  
Mr. Gary Parvin, Program Manager, ADST
- 16<sup>th</sup> Cavalry, Fort Knox  
COL Don Elder, Commander  
COL Greg Eckert, Commander
- TF 2-33 Armor, Fort Knox (LTC Joe Orr, Commander)
- 1 Brigade, 1 ID, Fort Riley (COL Doug Robinson, Commander)
- 3 Brigade, 2 ID, Fort Lewis (COL Pete Chiarelli, Commander)
- Lieutenant General (Ret.) Frederic J. Brown, Ph.D.

# REPORT ON THE EXPANDED METHODOLOGY FOR DEVELOPMENT OF STRUCTURED SIMULATION-BASED TRAINING PROGRAMS

## EXECUTIVE SUMMARY

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### Research Requirement:

The Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation (COBRAS) project was required to design, develop, implement, formatively evaluate, and document a structured, simulation-based training program. The program addressed staff skills for selected members of the staff of the conventional mounted brigade. Two levels of training were required: a large-scale integrated exercise that brought together virtually the entire brigade combat team and its assets, and a set of more focused small-group vignette exercises. The programs were to emphasize brigade staff processes in all phases of brigade mission operations: planning, preparation, and execution (to include the sustainment efforts of consolidation and reorganization). The program documentation requirement included preparation of a report on the methodology used to develop the training.

### Procedure:

The training design and development followed the guidance contained in the *Methodology for Development of Structured Simulation-Based Training* (Campbell, Campbell, Sanders, Flynn, & Myers, 1995). That methodology was based on work performed in development of execution-only training for platoons, companies, and battalions in the Virtual Training Program.

During the course of COBRAS design and development, changes in the original methodology were necessitated by the focus on a different echelon for the training audience, the coverage of phases other than execution, and the inclusion of combat support and combat service support elements. These changes did not invalidate the original methodology, which was surprisingly robust with respect to changes in focus. Developers and analysts documented areas in which the methodology remained constant and those areas that required expanded guidance.

### Findings:

The outcome of the documentation of the methodology modifications is this report on the expanded methodology. It incorporates discussion of the experience and lessons learned during COBRAS development, reported as a coherent presentation of the methodology process and its conceptual underpinnings in the *Systems Approach to Training*. A research product has also been generated, the *Guide to Development of Structured Simulation-Based Training* (Campbell & Deter, in preparation). The guide presents the enhanced methodology as a step-by-step process, and does not require reference to the original methodology. Both this report and the guide contain discussion of training support packages (TSPs) and formative evaluation discussion that were not included in the original methodology.

#### Utilization of Findings:

Both this report and the guide itself are addressed to training designers and developers, as well as to training program reviewers and proponents. The report will provide information and justification for the processes described in the guide. The guide contains the procedural instruction and examples that will enable other developers to construct sound, complete programs and that will assist reviewers in evaluating the strengths and completeness of developed programs.



# REPORT ON THE EXPANDED METHODOLOGY FOR DEVELOPMENT OF STRUCTURED SIMULATION-BASED TRAINING PROGRAMS

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# REPORT ON THE EXPANDED METHODOLOGY FOR DEVELOPMENT OF STRUCTURED SIMULATION-BASED TRAINING PROGRAMS

## Introduction

### Purpose

This report on the methodology for development of structured simulation-based training describes the conceptual underpinnings of the methodology, from its initial codification in 1995 to the current revision (the guide augmented by this report: Campbell, Deter, & Quinkert, in preparation). With this discussion in hand, evaluators and prospective users of the process can understand and appreciate (or take issue with) the basic tenets of the methodology, and adapt the process for their own needs.

The purpose of the guide itself is twofold:

- It expands the original methodology by incorporating lessons learned about development of structured simulation-based training.
- It includes discussion pertinent to the development and review of training support packages (TSPs).

The guide is intended for use by developers, reviewers, evaluators, and managers of structured training programs and their development.

### Background

In 1993-1995, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) sponsored a research and development effort to construct structured simulation-based training exercises for multiple echelons of the armored force. The finished program is known as the *Virtual Training Program* (VTP<sup>1</sup>). In addition to the training support package materials, project personnel also produced a report entitled *Methodology for Development of Structured Simulation-Based Training* (Campbell, Campbell, Sanders, Flynn, & Myers, 1995). The methodology is a step-by-step procedure that is based on the work performed in designing and developing the VTP training materials and scenarios.<sup>2</sup>

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<sup>1</sup> The program was originally known as the Reserve Component (RC) Virtual Training Program (RCVTP). As active units and schoolhouse training managers became interested in using the program, the "RC" designator was dropped. The work was performed as an ARI project entitled *Simulation-Based Training Multiechelon Training Program for Armor Units (SIMUTA)*, reported in Hoffman, Graves, Koger, Flynn, and Sever, 1995. Additional VTP work was performed in the project *Expansion of the Virtual Training Program (SIMUTA-B)*, reported in Graves & Myers, in preparation.

<sup>2</sup> The methodology itself is not specific to any particular technology, type of unit, unit level, or mission. It is, however, most applicable to the development of collective military training exercises that focus on tactical skills in planning and execution.

The VTP was developed for the use of U.S. Army National Guard (ARNG) units, to provide them with high-quality, time-compressed structured training in virtual and constructive environments.<sup>3</sup> Both offensive and defensive exercises are included for the battalion and battalion staff (armor battalion and battalion task force), company-level (armor company, company team, and cavalry troop), and platoon-level (armor platoon, mechanized infantry platoon, and scout platoon). For the staff, exercises either Janus (constructive simulation) as the behind-the-scenes driver; all other exercises are implemented using Simulation Networking (SIMNET) technology (virtual simulation).

Subsequent to its use in developing the VTP, the methodology (Campbell et al., 1995) has been used in the construction of similar structured, simulation-based training programs for brigade staffs<sup>4</sup>, for units equipped with digitized weapon systems<sup>5</sup>, and for conventional (nondigitized) forces on different simulations<sup>6</sup>. Adaptations were made as necessary to customize the methodology for each usage. The basic methodology, however, has proven to be robust with respect to differences in environments and training audience.

The most recently completed of these programs, and the one that serves as the basis for this report, is the *Force XXI Training Program: Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation*, usually referred to as COBRAS. On this ARI project, training exercises were developed for selected members of a conventional heavy mounted brigade. The training focuses on three missions (movement to contact, area defense, and deliberate attack) and on all phases of those missions (plan, prepare, and execute, including consolidation and reorganization).

Two types of training package were developed: the COBRAS Brigade Staff Exercise (BSE) and the Brigade Staff Vignettes.<sup>7</sup> In brief, the two types of training are described as follows:

---

<sup>3</sup> "Constructive simulations" are those where the technology represents actions and consequences, but does not replicate the full physical environment. "Virtual simulation" are those in which users actually interact with a replication of the physical environment, in much the same way that they would with the real environment. "Live simulation" refers to those situations where the real environment is reproduced in a less than full mode. Whether or not either constructive or virtual simulation technologies is used, all performance practice training involves some degree of live simulation, in that it involves real people in less-than-real conditions.

<sup>4</sup> *Simulation-Based Mounted Brigade Training Program (SIMBART)*, reported in Koger, Long, Britt, Sanders, Broadwater, and Brewer, 1996.

<sup>5</sup> *Simulation-Based Training for Digitized Units (SIMUTA-D)*, reported in Winsch, Garth, Ainslie, and Castleberry, 1996.

<sup>6</sup> *Structured Training for Units in the Close Combat Tactical Trainer (STRUCCTT)*, an ongoing ARI project.

<sup>7</sup> The COBRAS exercises and TSPs and the development process are more fully described in the project report: *Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation (COBRAS) Project: Development and Lessons Learned* (Graves et al., in preparation).

- The BSE integrates a large segment of the brigade staff and staffs of subordinate and supporting units, in a scenario based on a continuous storyline of all of the missions and phases. It makes use of the *Brigade/Battalion Battle Simulation (BBS)*.
- The vignettes are a series of 13 independent training exercises designed for small groups of brigade staff members. Each vignette focuses on a well-defined and delimited event, in order to provide concentrated practice on specific skills and behaviors for a small group training audience.

From the time the VTP was first being developed until the COBRAS training programs were delivered, there has been increasing interest in the training support packages (TSPs) that operationally define structured training programs. TSPs have been variously defined:

- In the VTP-derived methodology, the TSP was envisioned as a two-part set of materials: those for the trainer, and those for the trainee.
- Several months after the methodology was published, in an early COBRAS briefing for MG Maggart (Commanding General, Armor Center and Fort Knox), there were four components: tactical materials, training audience materials, trainer materials, and simulation materials.
- Currently, The U. S. Army Training and Doctrine Command (TRADOC) Regulation 350-70 calls for five components: tactical, training audience, trainer, simulation, and administrative (Department of the Army [DA], 1995).

While these ways of classifying materials vary, the content itself is substantively the same for all three models. Increased attention to the content of TSPs, as well as their organizing architecture, led to more definitive descriptions of model TSPs. The current guide includes specific considerations for developing TSP components for structured training programs.

### **Contents and Organization of the Report and Guide**

The report itself comprises four sections:

- This section of the report, *Introduction*, contains a discussion of the background of the methodology and characteristics of structured training and TSPs.
- The next section of the report, *Overview of the Methodology*, contains a discussion of the methodology approach, delineating its relationship to the Systems Approach to Training [SAT] (DA, 1988) and describing the formative evaluation philosophy for the methodology.
- The third section of the report, *Overview of the Guide*, contains an overview of the organization of the guide.
- The fourth section of the report is the *Summary*, and includes discussion of the potential users of the report and the guide.

This report is intended to provide details concerning the development of the methodology. It can be read and understood without reference to the guide. Likewise, the guide itself may be read and used without reading the report.

The guide itself contains detailed discussion and instructions on the use of the methodology, not specific to any simulation technology, mission, or unit type. The guide:

- describes the activities to be followed in developing the exercise components (e.g., scenarios and trainer materials),
- indicates where revision loops occur,
- details review and tryout (i.e., formative evaluation) requirements, and
- describes the products from each activity and how they feed into subsequent activities.

This version of the guide both expands and revises the earlier version (Campbell et al., 1995). Although the original version held up robustly during subsequent uses, it was, in retrospect, somewhat restrictive in scope. As experience with construction of structured training has accumulated, understanding of the opportunities for flexibility has increased. This version of the methodology seeks to encourage creativity, offer more flexible guidance, and allow for departures from the model.

While the tenets for development of structured training are appropriate in nonmilitary training settings and in a live simulation mode, this methodology is couched in military and constructive/virtual/live simulation-based training terms. As appropriate, guidance is provided for development of training for both tactical battlefield-oriented training and also for training of skills such as planning and decision-making processes.

The appendix in this report contains a job aid version of the methodology, in the form of an outline and job aid checklist for developers and reviewers. While the guide contains details and discussion of the procedure, the appendix summarizes the process and serves as a handy reference for more experienced developers.

### **Structured Training Characteristics**

The term “structured training” is widely used in current training discussions. It is generally assumed that there exists a commonly accepted definition. However, the term is rarely defined at the start of the discussion, despite the fact that various definitions are in use. Some of those definitions are as follows:

- Structured training is often said to be task-driven, rather than event-driven. This may mean that
  - practice and feedback are directed at specific tasks rather than at the events that happen to occur during an exercise; or

- training should be planned to address task proficiency needs, rather than to satisfy a scheduled training event (such as a rotation to a combat training center [CTC] or a field training exercise [FTX]).
- Another usage of the term “structured training” implies that a carefully designed set of initial conditions (e.g., mission, enemy, troops, terrain, and time available [METT-T]) has been defined for the exercise. Once the exercise begins, little additional structure is imposed.
- Yet another definition refers to the “. . . totality of training development, training support, and guidance for effective application/use within the unit or institution” (Brown, 1993, p. 2).

None of the usages or definitions above restricts the focus of the training to a particular audience, setting, or implementation model. In fact, the term has been used to refer to various training programs, including the following:

- Training that is directed to the individual, small groups, or units (military or otherwise).
- Training for a single level or echelon, or training for several levels linked by means of common scenarios or through simultaneous involvement in the training.
- Training that involves use of constructive or virtual simulations or training that involves only live simulation (although all training involves a degree of live simulation).
- Training that is turn-key training for the participants as well as training that requires participant planning and preparation.

In all cases, however, the task-directed structure is intended to maximize the training value for all participants.

A comprehensive definition of structured training is presented in Figure 1. It encompasses each of the definitions and usages described above, and forms the basis of the methodology presented in the guide. It indicates the importance of a careful process of needs analysis and critical task selection as the basis for the training program. These preliminary steps lead into preparation of the supporting materials that comprise the TSP. The TSP provides two kinds of tools:

- The scenario and support guides that provide the cues to control the *training process* (i.e., the behaviors and activities of the trainers in controlling the flow of the exercise), and
- The training objectives, observation guides, and associated after action review (AAR) materials that support the *learning process* (i.e., the activities of the training audience and the means for providing feedback to them).

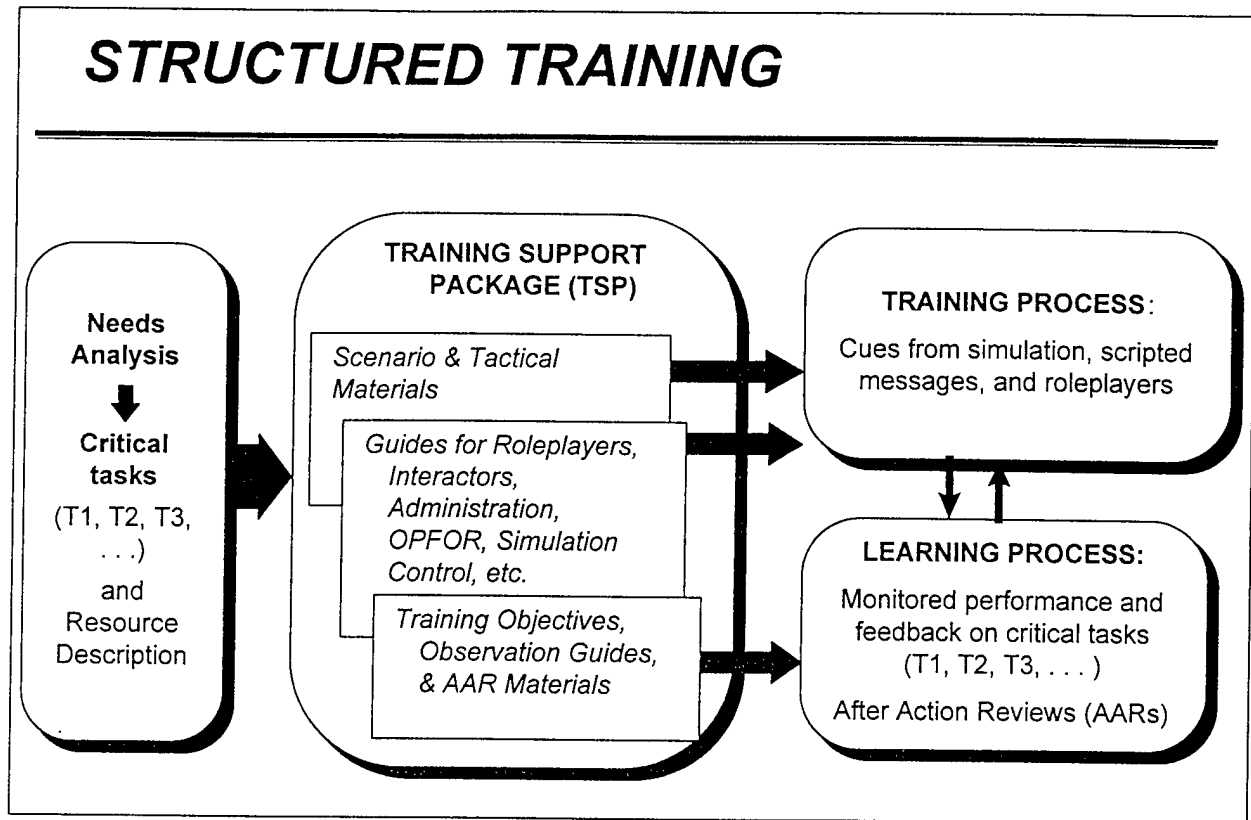


Figure 1. The structure of structured training.

For the programs developed under ARI at Fort Knox, structured training is operationally defined as training that is deliberately and purposefully constructed so as to focus on specific training objectives. The concept incorporates several key features:

- a focus on performance of selected critical tasks
- standardized exercise control to ensure practice of the tasks
- standardized feedback to correct and reinforce performance on the selected tasks
- exercise support by means of comprehensive training materials.

The development methodology described here incorporates those features while following accepted instructional design. It also incorporates two other features that are *not* essential to the definition of structured training:

- It takes advantage of virtual, constructive, and/or live simulation capabilities.
- It is embedded in the context of tactically realistic scenarios, causing the unit to be immersed in the (simulated) tactical situation that elicits performance of the critical tasks.

The training focus is ensured by means of careful attention to standardized implementation and doctrinal guidance, and is accomplished by adhering to the following guidelines<sup>8</sup>:

- The conditions that provide the setting for the training should be closely defined and crafted to be realistic for task performance.
- The selected tasks that form the training objectives should be doctrinally correct. This means that, whether they are drawn directly from published documentation or are elaboration of documented procedures, there should be acceptance of the technical accuracy of the tasks and how they must be performed.
- The training should take advantage of and work within the capabilities of the selected simulator/simulation.
- The training materials should support all aspects of the training; that is, the unit's focus should be on participating in the training, rather than on designing and developing the training, or on observing and evaluating their own performance.
- The materials should permit standardized (that is, replicable) implementation of the program, so that the selected tasks are cued consistently.
- The training should support a selected training sequence with regard to task performance (e.g., crawl-walk-run, natural order, hierarchical order).
- The training should make use of performance observers, and materials should direct their attention to the key training objectives.
- The training should be designed to fit within the typical unit's time and resource constraints.
- The training materials should be flexible, so that different situations can be accommodated, and should also include warnings and explanations about what should *not* be modified.

### **Training Support Package Products**

The products of a structured simulation-based training development project comprise the TSP. For the ARI-sponsored projects and as defined in TRADOC Reg 350-70 (DA, 1995), the TSP structure is shown in Figure 2. The TSP components include:

- *Tactical materials for the training audience and other participants.* Such materials may include operations orders (OPORDs) and other mission-specific materials to be used in unit preparation and rehearsals, prepared messages and scripted materials that are used during the exercise to cue tasks, and descriptions of personnel and equipment status to set the scenario conditions.

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<sup>8</sup> The originally proposed principles have been modified, based on experience and lessons learned in subsequent projects.



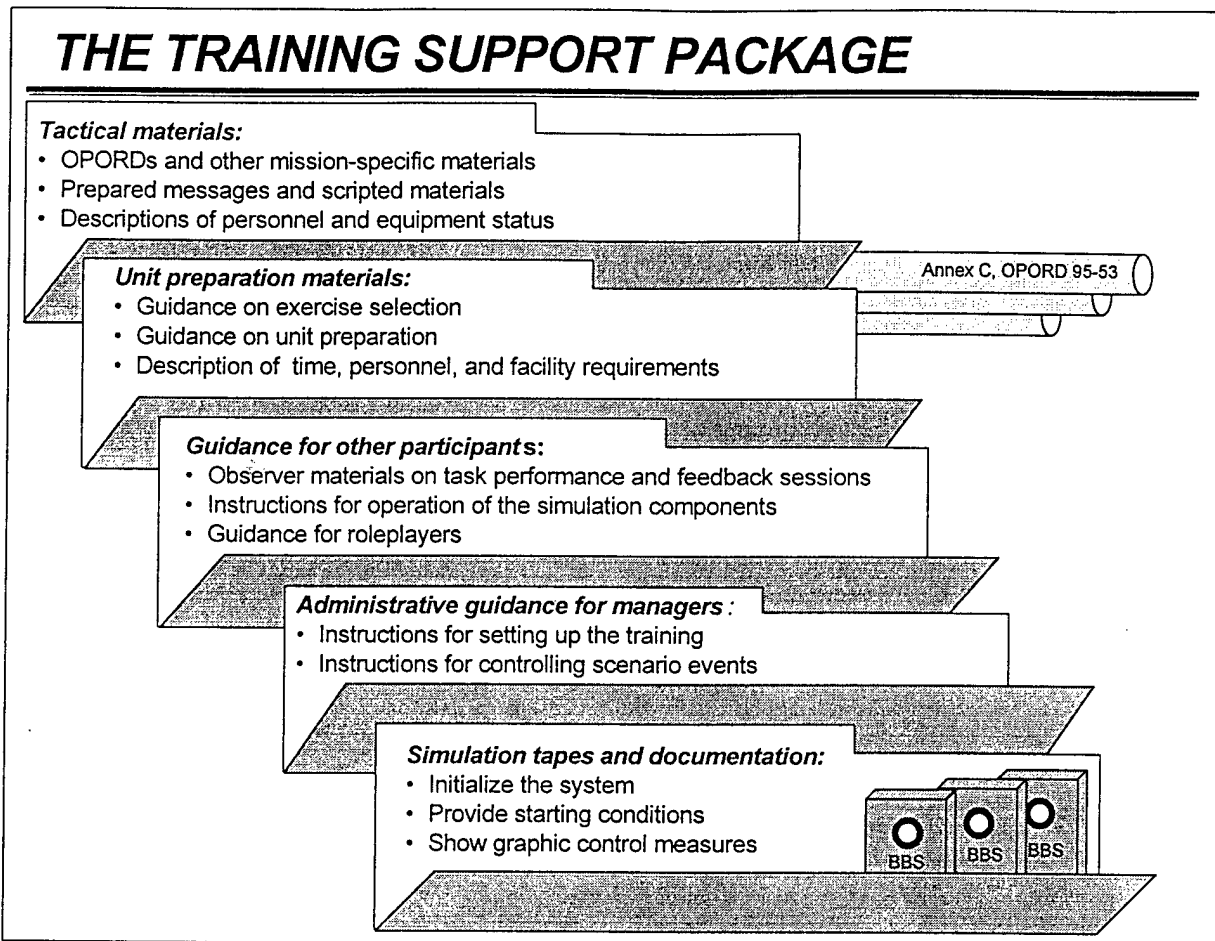


Figure 2. Components of a training support package for a structured simulation-based training program.

- *Preparation materials for the training audience.* These assist unit leaders in selecting the appropriate training for their needs, provide guidance on unit preparation, and describe the time, personnel, and facility requirements.
- *Guidance for other participants.* This includes observer materials that direct attention to specific task performance, describe acceptable performance, and outline the feedback sessions; instructions for operation of the simulation components; and guidance for roleplayers who interact with the unit during the exercise. Because all of these participants who are *not* the primary training audience are actually “trainers,” these guides represent the “train the trainer” materials.
- *Administrative guidance for managers of the training.* These include instructions and suggestions for setting up the training and controlling scenario events.

- *Simulation tapes and documentation.* These are used with the selected constructive or virtual simulation to initialize the system, provide starting conditions (e.g., locations, task organization), and show graphic control measures. The documentation is provided as back-up in case the initialization tapes are unusable.

This outline for the components of a TSP allows developers considerable latitude in organizing and presenting their materials. Such flexibility is essential, because every structured training program will require an individually prepared TSP, specific to the requirements of that program.

Structured training programs and TSPs are and should be closely associated. In fact, those who work on the ARI training development projects have come to regard the two concepts as inseparable. Even a structured program that appears to have no TSP will be seen to have an implicit TSP, in the mind and person of a proficient trainer. On the other hand, a TSP can be developed for an unstructured training program, but that TSP will be incomplete in that it will not include task cues. Therefore, throughout this methodology report and the guide, structured training and the TSP that goes with it are equally the focus.

#### **Note on the Original Methodology Report**

The original methodology (Campbell et al., 1995) has certain items that may be of interest to developers and that are not included in this revision:

- Section 4, *Training* is addressed to developers who will have the assistance of a dedicated training cadre when the program is implemented.
- Section 5, *Using the Methodology for Training Program Modifications*, discusses various topics related to the development methodology, including extension of existing exercises to other METT-T and description of ongoing efforts using the methodology.
- Several different worksheets were designed to aid in preparation and quality control of structured training programs; fill-in-the-blank worksheets are provided in Appendix B of the original methodology (Campbell et al., 1995)
- Appendix C of the original methodology (Campbell et al., 1995) contains discussion and examples of how the activities were performed in developing the VTP. The process for each echelon is discussed in those sections, as follows:
  - Part 1, *Platoon-Level Training*
  - Part 2, *Company-Level Training*
  - Part 3, *Battalion-Level Training*
  - Part 4, *Battalion Staff Training*.

## Overview Of The Methodology

This section establishes the methodology's relationship to the existing *SAT* model (DA, 1988) and describes the developmental and formative evaluation activities in the methodology.

### The Methodology and the Systems Approach to Training

The methodology for developing structured simulation-based training exercises originated in the *SAT* model (DA, 1988). The SAT process comprises five phases:

- *Analysis*—Determine the training requirement, training audience, and appropriate training media.
- *Design*—Prepare the specifications of the training components.
- *Development*—Construct and refine the various training package components.
- *Implementation*—Deliver the training in an operational setting.
- *Evaluation*—Assess success in achieving the program's training goals.

The development methodology described here parallels the SAT process in most respects. However, the SAT activities phases have been narrowed in this methodology to focus on the development of structured training that uses simulation. This methodology concentrates primarily on *Analysis* (including certain initial decisions and selection of training objectives), *Design* (including other initial decisions and specification of the exercise limits), and *Development* (construction of TSP components, tryouts, and formative evaluation).

### Developmental Activities in the Methodology

There are four phases to this development methodology, as shown in Figure 4:

- *Phase 1: Initial Decisions*—Determine the training requirement (e.g., mission and enemy type, terrain, time constraints, number of exercise start points, difficulty level), training audience (e.g., unit type or echelon, personnel within unit), and appropriate training environment (i.e., specific simulator/simulation).
- *Phase 2: Select Training Objectives*—Focus the training on critical tasks and performance standards in support of the training requirements, and ensure that those tasks can be performed in the selected simulator/simulation environment.
- *Phase 3: Design Scenario and Exercise Structure*—Determine the limits of each exercise with reference to METT-T; generate the tactical framework for the exercises; specify the events within each exercise; define and put substance to the roles to be played by the simulation and by various types of trainers; and crosswalk the training objectives to events within the exercises.

## PHASES OF THE DEVELOPMENT METHODOLOGY

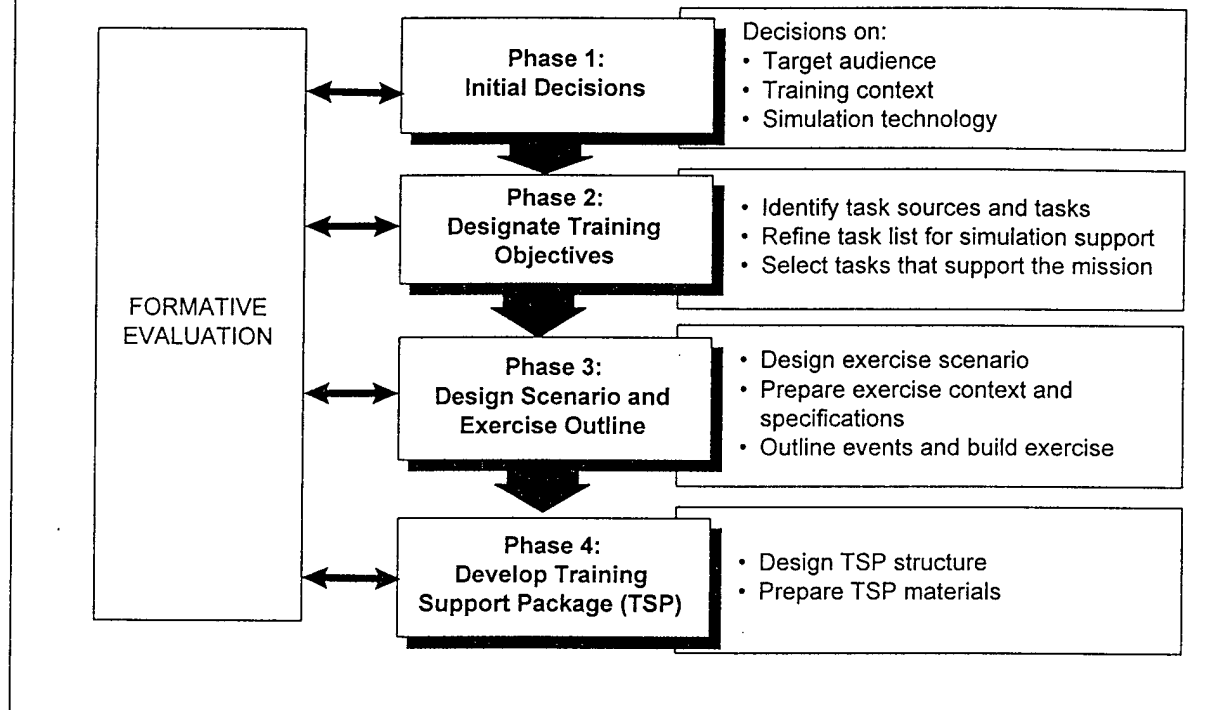


Figure 3. The four phases in the methodology for development of structured simulation-based training.

- *Phase 4: Develop Training Support Package (TSP)*—Construct and try out all of the written and simulator/simulation-based components of the training program, including materials for the trainers and for the participating unit.

These four phases need not be done in a strictly linear fashion. There should be considerable overlap among the phases. For example, understanding of the initial decisions will change as more is learned about the simulation and the tasks; information that feeds into development of the TSP will be captured during documentation of initial decisions; and so on.

The SAT *implementation* and *evaluation* phases are not explicitly replicated in the development methodology. Both operational implementation and the summative evaluation take place after the activities covered by the methodology, when the training package is received by the user. However, the methodology does contain the developmental parallel processes: pilot and trial implementations and formative evaluations.

## **Formative Evaluation Activities in the Methodology**

The development methodology incorporates a series of required and critical *formative evaluation* steps throughout the development process.<sup>9</sup> Some of these are formal activities (such as map exercises conducted by the design team, tryouts with representative or surrogate units and individuals, technology-driven tryouts, or content reviews with experts and stakeholders or proponents<sup>10</sup>), but formative evaluation also includes a continuous attention to the need for revisions and improvements. The purpose of formative evaluation, both the formal activities and the continuous revisions, is to insure the quality of the product by attending to quality throughout development. In Figure 3, formative evaluation is shown as underlying all phases of development. This continuous improvement and revision process, which derives from the formative evaluation attention, is what causes design and development to be non-linear, as mentioned above.

In the guide, appropriate formative evaluation activities are described for each of the developmental activities. Each formative evaluation activity has a specific focus, appropriate to the development activity, and the information gathered is used to revise and refine products or to ensure the accuracy and usability of the products. Briefly, the formative evaluation activities for each phase of the methodology include the following:

- For Phase 1 (Initial Decisions), the formative evaluation task will be to make sure that all of the parameters of the proposed structured training have been examined by those who have commissioned the training. All of the directives that have been given by the training program proponent (the office or individual who is sponsoring or has directed that the development be done) should be documented by the developers and approved by that proponent. This will ensure that the development is on track with the initial intent. It is crucial that the proponent review and approve of any changes in the design and development work.
- In Phase 2 activities (Designate Training Objectives), developers will be identifying the specific training objectives for the program. These are the tasks that the program will address and train, and the standards for task achievement. The formative evaluation in Phase 2 should take the form of an expert review of the selected tasks. This review should involve any offices or agencies who are responsible for doctrine and documentation for the subject matter (e.g., doctrine or training or tactics directorates). These agencies have a vested interest in the product and a responsibility for its accuracy; they are also knowledgeable and can provide valuable information and support.
- As development proceeds in Phase 3 (Design Scenario and Exercise Structure), the formative evaluation will become more active, involving map exercises and simulation-controlled exercises, and finally exercises with representative (or surrogate) participants (usually referred to as “pilots”). These exercises are intended to evaluate the technical

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<sup>9</sup> The formative evaluation activities were termed “quality reviews” in the original methodology.

<sup>10</sup> By “proponent,” we mean whoever decided that the training was required. This person or agency is usually the primary client for the development effort.

content of the development, with regard to both doctrine and simulation. There is still a requirement for proponent and expert reviews of the scenario, to ensure that the evolving design is still consistent with the intent.

- Finally, in Phase 4 (Develop Training Support Package), the formative evaluation will involve representative individuals and units in trying out the program's TSP (referred to as "trials"). By this time, developers should have performed reviews to ensure that the exercises are doctrinally correct and that they are matched to simulation capabilities. They are now ready to check on how usable the exercises are and whether training (and learning) occurs. These trials are extensive and require careful planning, rigorous and intensive information-gathering, and documentation of resulting actions. They are the final point of revision and will demand excruciating attention to detail in order to ensure that all materials are complete and correct.

In the VTP development, all of these formative evaluation steps were followed, and were often repeated as additional revisions were made. In the COBRAS development, several expedient methods had to be developed because of the inability to obtain sufficient representative participants; they are discussed in the COBRAS final report (Graves et al., in preparation).

### Overview of the Guide<sup>11</sup>

The detailed guidance regarding the application of the methodology is contained in the *Guide to Development of Structured, Simulation-Based Training*. There are nine *Activities* within the four phases of the methodology.<sup>12</sup> In the guide, each phase of the methodology is introduced by a discussion of the purpose of that phase, along with a list of the activities in the phase. Each activity is then presented with a lengthy explication of the considerations for that activity.

### The Development Process

The nine activities should, in general, be performed in the order described. However, the process is not meant to be rigid. The continuous attention to formative evaluation during an activity will often cause you to go back and revise the products of an earlier activity. In fact, developers should regard the entire process as flexible, and be prepared to move back and forth between activities during the development, revising decisions and products as necessary.

***Whenever decisions or products are revised, developers must trace back through earlier development and correct all related products,*** whether they are interim products or parts of the final TSP. We cannot emphasize too strongly the importance of keeping all products current and

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<sup>11</sup> Extracts of this section are also included in foreword to *The Guide to the Methodology for Development of Structured Simulation Based Training*.

<sup>12</sup> Ten activities were included in the original methodology (Campbell et al., 1995). Two of the activities (3.1 and 3.2) were combined into a single activity in this version.

in agreement with each other. We should also point out that, in our experience, this is one of the most difficult challenges in development.

Although the guide presents a succinct procedure for developing structured simulation-based training, the guide alone will not be sufficient for development. Subject matter expertise for the selected technology, for associated military aspects (e.g., the mission type, unit type, operations, and enemy tactics), and for training and instructional design will be required throughout the development and review processes.

### **The Methodology Outline (Appendix)**

The appendix of the guide (also included as an appendix to this report) presents, in outline form, the phases, activities, and formative evaluation considerations in the methodology. As appropriate, some of the most important design and development considerations are also listed. For each of the activities, the outline indicates the activity's product or outcome. Not all of the indicated products are used in the final TSP; some are interim products that assist developers in moving through the development process.

The appendix serves as a job aid or checklist for the development process and includes little detail or explanation. It is designed to help maintain high quality in the TSP materials. It lists the characteristics of correct and complete TSP materials. Thus, it should be used to remind experienced developers and reviewers of the critical elements of the development process and the TSPs.

### **Formative Evaluation Activities**

The various types of formative evaluation activities described in the guide provide information appropriate to each stage of development, from the basic decisions, through the development of supporting pieces of the exercises, to actual materials in the TSP. The formative evaluation activities will draw your attention to the many ways that the materials must be carefully checked, verified, and corrected.

In each of the activity discussions in the guide, the "Formative Evaluation" step is emphasized by means of a separately headed section to ensure that it receives sufficient attention.

### **Summary**

This report is intended to accompany the *Guide to Development of Structured Simulation-Based Training*. It has presented the history of ARI-sponsored structured training programs. It also contains a discussion of structured training and training support packages. Finally, the report has described the basic structure of the methodology and the guide.

By following the process described in the guide, various objectives for various users may be met:

- *Training developers* will be confronted with most of the critical considerations that must be faced in designing and developing structured simulation-based training programs.
- *Reviewers* of training program development projects or of TSPs will find that the methodology outlines the issues that should be addressed in development and the considerations that should be incorporated into the TSP.
- *Evaluators* of training programs and TSPs will be able to identify the probable causes of weaknesses in programs by tracing through the critical development steps.
- *Managers* who oversee the development and implementation of structured training programs will be better equipped to modify the developmental process and elements of the TSP, through a full appreciation of the prescribed methodology.

### **Performing Organizations**

The COBRAS Team, which was responsible for the design and development of the training program that formed the basis for this revision of the methodology, includes: Human Resources Research Organization (HumRRO); Hughes Training, Incorporated; BDM, Federal; and PRC, Incorporated.



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## **APPENDIX**

### **Guide to Development of Structured Simulation-Based Training**

#### **OUTLINE OF THE METHODOLOGY**

## Phase 1. Initial Decisions

### Activity 1. Document Initial Decisions

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<b>Product or outcome</b>	Documentation of decisions
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<b>Formative evaluation</b>	Proponent review
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*Decision areas  
(pages 7-10  
of the Guide)*

1. Target training audience
  2. Training context
    - Mission type
    - Enemy type
    - Terrain/locale
    - Unit type
  3. Simulation technology
  4. Other, e.g.:
    - Exercise time
    - Number of entry points
    - Nature of entry points
    - Linkages to other programs
    - Guidance for training priorities
    - Trainer and other resources
-

## Phase 2. Designate Training Objectives

 **NOTE** Either Activity 2.2 or Activity 2.3 can be done first. Do whichever you think will reduce the task list *most*.

 **NOTE** Phase 2 and Phase 3 (designing the scenario and exercise structure) will probably be iterative.

### Activity 2.1 Identify Task Sources, Tasks, and Standards

**Product or  
outcome**

Tasks and standards; task sources

**Formative  
evaluation**

Internal and proponent review

*Sources  
(pages 12-13  
of the Guide)*

- Doctrinal — ARTEP-MTPs, FMs, proponent agency lists
- Other — job and task analysis

*Task detailing  
(page 13  
of the Guide)*

- Task statement — lowest level of collective behavior that has accompanying conditions and standards
- Conditions statement — description of situation, environment, and initiating cues that should cause a task to be performed
- Standard — statement of correct, acceptable, ideal accomplishment of a task

## Activity 2.2 Refine Task List for Simulation Support

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<b>Product or outcome</b>	Task list annotated to show tasks that can be fully or partially performed and observed in the simulation
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<b>Formative evaluation</b>	Internal and proponent review
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*Judgments of simulation support (pages 14-15 of the Guide)*

- Use a rule-based system
  - Use more than one judge; reconcile judgments
  - Use task expert and simulation expert
  - Document partial trainability (which parts)
  - Determine whether the task:
    - *Can be performed* in simulation
    - *Should be trained* in simulation setting
    - *Can be performed* in the simulation setting, though not simulation-supported
- 

## Activity 2.3 Select Tasks That Support the Mission

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<b>Product or outcome</b>	Reduced task list, annotated to show the tasks (or parts of tasks) that will be performed and can be observed in the context of the mission, along with appropriate conditions and standards
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<b>Formative evaluation</b>	Proponent review; training and doctrine agency review
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*Selecting tasks (and standards) (page 16 of the Guide)*

- Are part of the mission(s) to be training (per Activity 1)
  - *Can* and *should* be trained in the simulation, can be *observed*
  - “Other” guidance for training priorities satisfied
-

## Phase 3. Design Scenario and Exercise Structure

**NOTE**

Phase 2 and Phase 3 (designing the scenario and exercise structure) will probably be iterative.

Phase 3 activities are closely tied and highly interdependent. Compare unit's and higher echelon's missions and scenario outlines frequently to ensure tactical correspondence.

*Task sequencing  
(pages 17-18  
of the Guide)*

Common sequencing approaches:

- Crawl-walk-run
- Natural order
- Hierarchical
- Easy-to-difficult

### Activity 3.1 Design the Scenario

**Product or  
outcome**

Draft of the "concept of the operation" with sketch of graphic overlay, draft of unit OPORD, or other method of presentation; for training unit and higher echelons as necessary

**Formative  
evaluation**

Map exercises

*Continued on next page*

## Activity 3.1 Design the Scenario, Continued

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*Design  
principles  
(page 19  
of the Guide)*

1. Situation should be realistic
    - Cues match real-world conditions
    - Tactical materials resemble actual materials (1-2 levels up)
    - Plausible activities at higher echelons
  2. Enemy should be realistic
    - Organization, equipment, tactics, techniques, procedures consistent with its doctrine
  3. Real-time, real-space events
    - Minimal magic moves and reconstitution
    - Time only moves forward
    - Constant terrain
    - Partitions at natural breaks
- 

*Components of  
mission outline  
(page 20  
of the Guide)*

1. Initial locations (friendly and enemy)
  2. Major events list
  3. Participants (actual and notional, friendly and enemy)
  4. Terrain area or environment
  5. Task by event crosswalk
- 

*Battle-oriented  
exercise  
products  
(page 20  
of the Guide)*

- Description of mission and commander's intent
  - Enemy plan (locations, objectives, mission, intent, etc.)
  - Terrain to support mission, sketch of graphic control measures
  - Scenario timeline showing friendly and enemy activities
-

## Activity 3.2 Prepare Exercise Context and Specifications

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**Product or outcome**

Context, specifications, and execution details for exercises

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**Formative evaluation**

Simulation-controlled exercise to verify the following:

- Match between specifications and simulation
  - Suitability of terrain
  - Exercise length
  - Correlation of forces
- 

*Product description  
(page 22-23  
of the Guide)*

1. Narrative/graphic representation
  2. Friendly and enemy situations
    - Equipment/personnel status
    - Recent events
    - Starting locations (approximate)
  3. Unit specifications at starting point
    - Unit identifiers and type unit, how represented
    - Initial status of each system
  4. Exercise ending point—approximate location or event
  5. Scenario description—exercise intent, i.e., overall objective, general statement of conditions
  6. Tasks/training objectives
-



## Activity 3.3 Outline Events and Build Exercise

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**Product or outcome**

Master event list showing cues, expected performance, and critical tasks or subtasks; simulation files

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**Formative evaluation**  
*(page 25-26 of the Guide)*

Pilot with knowledgeable personnel to check the following:

- Scenario and order are appropriate for terrain and events
  - Exercise specifications for all units are correct
  - Locations permit exercise to proceed as planned
  - Event cues cause tasks to happen
  - Performance is observable
  - Performance standards are clear and observable
- 

*Elements*  
*(page 24 of the Guide)*

- Cue to start event
  - Unit response
  - Task to be observed
-

## Phase 4. Develop Training Support Package (TSP)



### NOTE

TSPs are unique to the training programs they support.

#### *Necessary inputs*

- What will the implementation setting be?
- Who are the users (implementers and training unit)?
- How will they use the materials?
- What should the materials help them do?

### Activity 4.1 Design TSP Structure

#### **Product or outcome**

Design outline for TSP components that considers (at a minimum):

- Use of tactical and other scenario materials
- Unit preparation (training audience)
- Materials to aid or train other participants
- Simulation needs
- Exercise management
- TSP packaging

#### **Formative evaluation**

Proponent review and review by representative users

*Continued on next page*

## Activity 4.1 Design TSP Structure, Continued

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*Considerations  
(expanded list)  
(pages 28-29  
of the Guide)*

1. Tactical and other scenario materials
    - What is needed, when is it distributed, who gets it, how do they know what to do with it?
  2. Unit preparation (training audience)
    - Prior experience, current skill level, time available for preparation, what preparation is needed, what media for providing information?
  3. Materials to aid or train other participants
    - Who are the other participants (observers, roleplayers, interactors), prior experience, functions or roles, what job aids can be used?
  4. Simulation needs
    - How will scenario be transferred to simulation, who does it, what instructions needed?
  5. Exercise management
    - Who will manage the training, prior experience, resources?
  6. TSP packaging
    - How will the TSP be packaged and distributed?
    - Be aware of differences between the shelf (master) copy and distribution copy.
-

## Activity 4.2 Prepare TSP Materials

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**Product or outcome**

The TSP, as outlined in Activity 4.1.

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**Formative evaluation**

Expert reviews, trials with representative personnel

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*TSP principles  
(page 38  
of the Guide)*

- Clear organization
  - Easily readable and understandable appearance
  - Timely use of graphics and tables
  - Extensive use of appropriate job aids
- 

*Expert review  
guidelines  
(page 39 of the  
Guide)*

- Simulation experts for materials used to program or configure simulation
  - Doctrinal experts for tactical materials and AAR materials
  - Someone familiar with training needs and constraints for advance materials (unit preparation) and management materials
  - Instructional design experts for structure and presentation mode
  - Someone for roleplay of unpacking, reproducing, distributing
- 

*Continued on next page*

## Activity 4.2 Prepare TSP Materials, Continued

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*Trial guidelines  
(page 39-40  
of the Guide)*

1. Use actual (representative) participants in all positions, if possible
  2. Use actual TSP materials
  3. Let participants use materials; intervene only in case of fatal errors
  4. Collect information via
    - Observations
    - Group discussions before, during, after exercise
    - Structured interviews
    - Questionnaires
  5. Focus on
    - Assumptions and expectations
    - Methods for conducting exercise
    - Clarity and utility of materials
    - Completeness of materials and absence of extraneous materials
  6. Have a formal plan
-